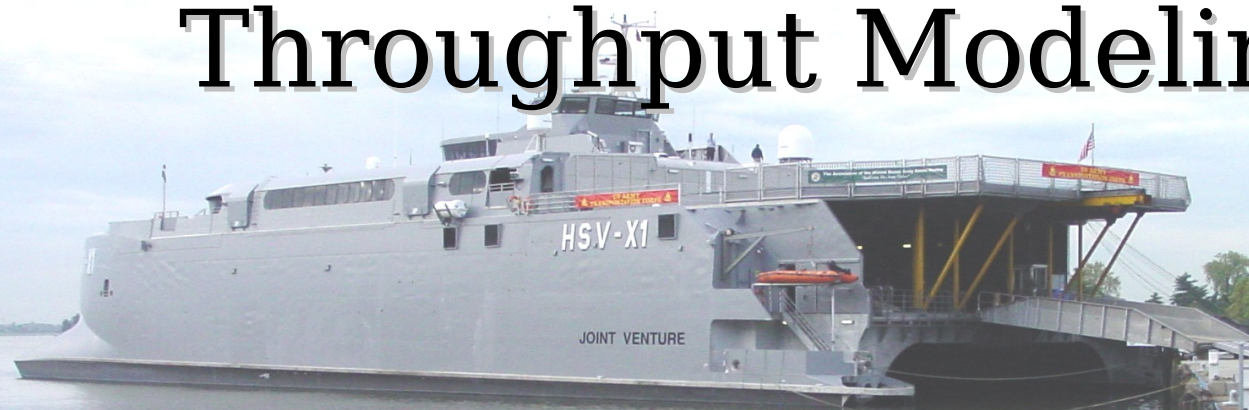


Future Seaport of Debarkation (SPOD) Egress Throughput Modeling



**JLOTS Symposium
January 28, 2004**

**Team: Greg Green, ERDC
Alex Baylot, ERDC
George Mason, ERDC**



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Center**

THREE ELEMENTS OF RAPID PORT ENHANCEMENT

1. **Port Characterization** (ingress/egress)
[includes IITRI, CASCOM, USMC involvement]
2. **Throughput Simulation** (ingress/egress)
[includes IITRI, MTMC, other (?) involvement]
3. **Causeway Development**
[coordinated with CASCOM, DPMO, MANSCEN]



Objectives....

- To identify a comprehensive set of environmental and physical factors pertinent to egress throughput rates through small ports
- Research existing algorithms and develop relationships that can be used in throughput and force projection models and analysis tools to produce accurate results
- Develop an analysis tool for throughput and force projection



THROUGHPUT SIMULATION:

1. Develop algorithms / collect data
2. Test/verify algorithms
3. Interface with other applications
4. Collect/infer data and develop “impact” assessment on throughput
5. Evaluate engineer operations for upgrades
6. Site planning/selection (in conjunction with port characterization information)



Environmental Data **Important to Egress** **Operations**

- Weather - precipitation, visibility
- Terrain (offroad) - soils, vegetation, surface roughness, obstacles (ditches, levees, embankments, drainage features)
- Terrain (onroad) - road type, road conditions, road capacity, CBR, obstacles (rubble & debris, craters), bridges, tunnels, barriers, chokepoints & bottlenecks
- Engineer operations – upgrade time and equipment for infrastructure

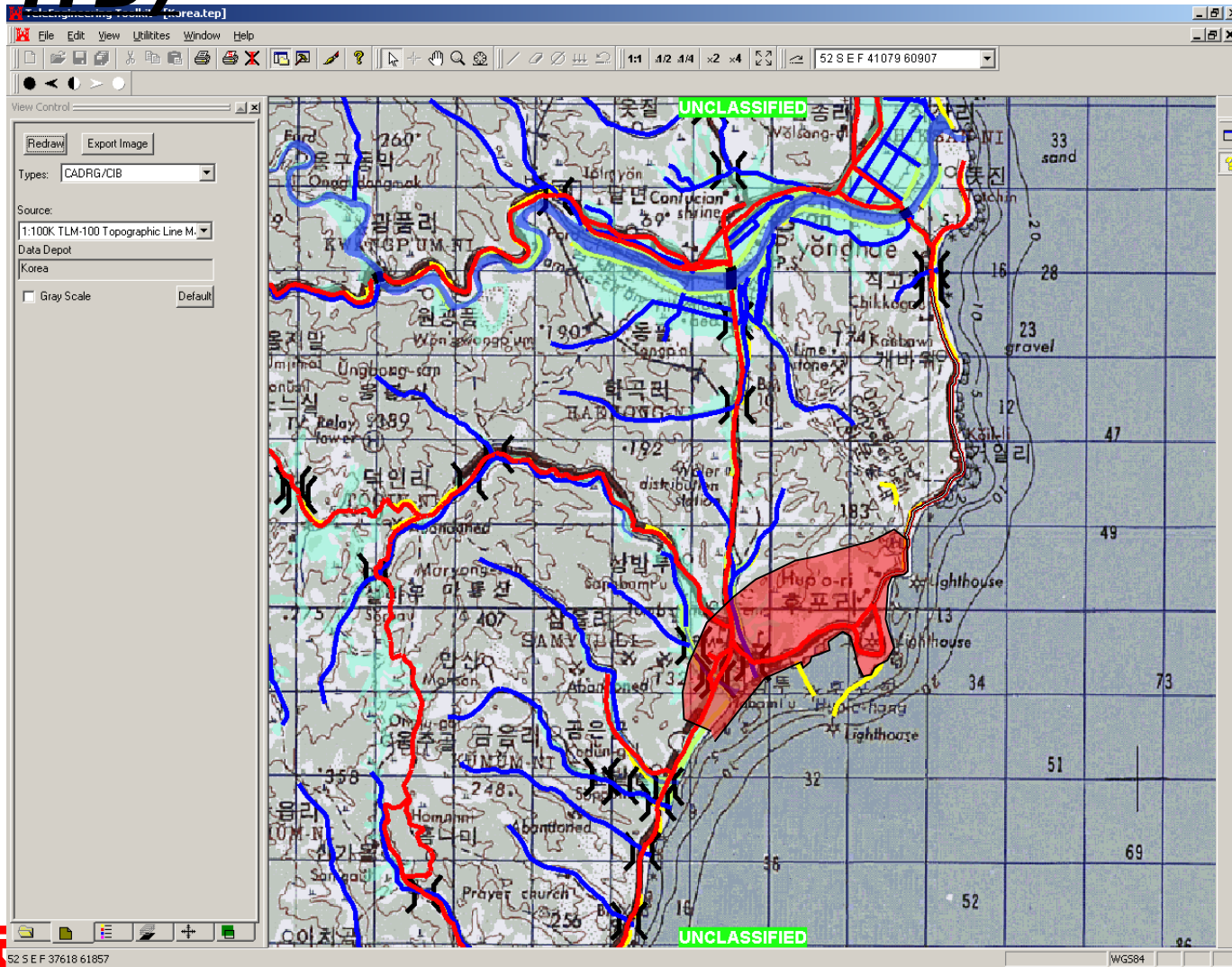


Environmental Data **Important to Egress** **Operations**

- NIMA
- USGS
- Subject Matter Experts (Field Manuals, Technical Reports, Journal Articles, References)
- Empirical models (NRMM, CMM, STNDMob)
- Theoretical models (VEHDYN, DADS)
- Field Test Results (ERDC, APG)
- Ground Recon



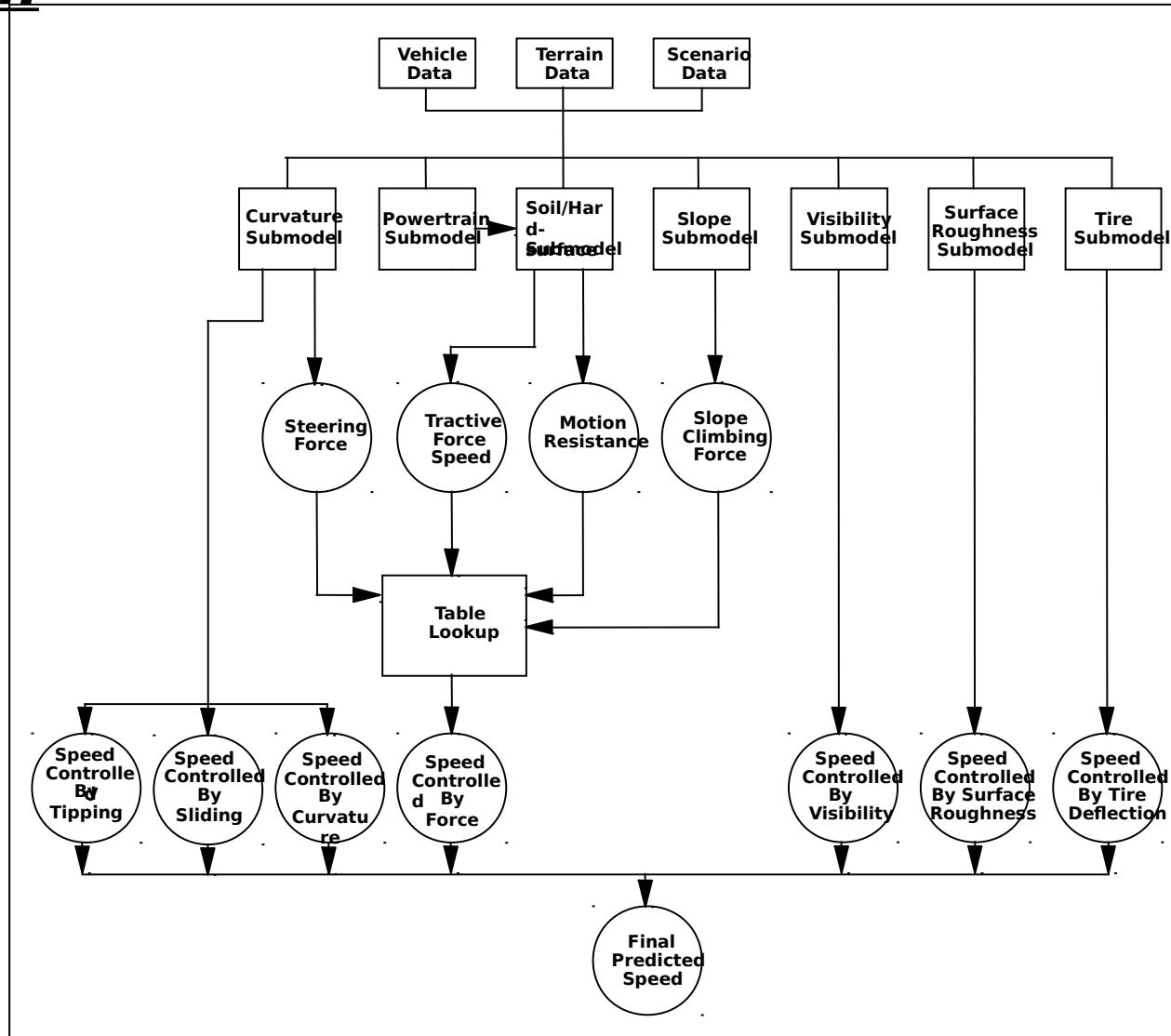
NIMA products (Maps, ITD)



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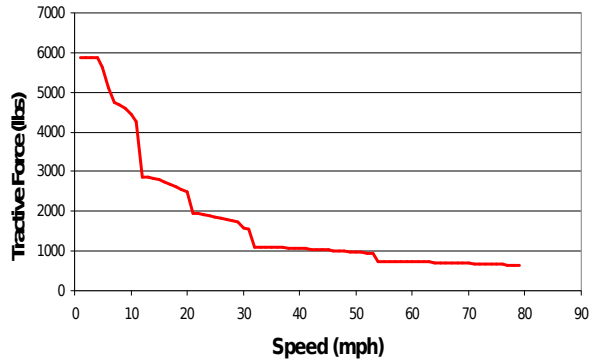
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NRMM On-Road Speed Prediction Flow Diagram

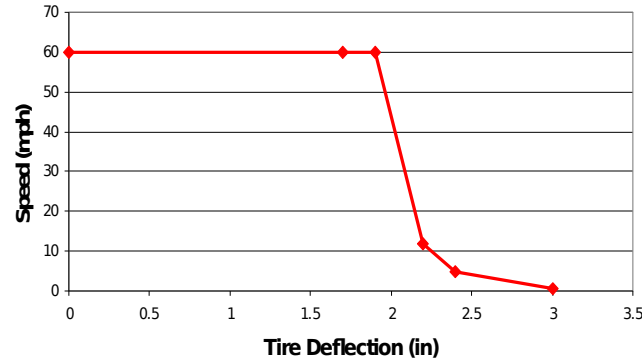


Important Urban Mobility Relationships

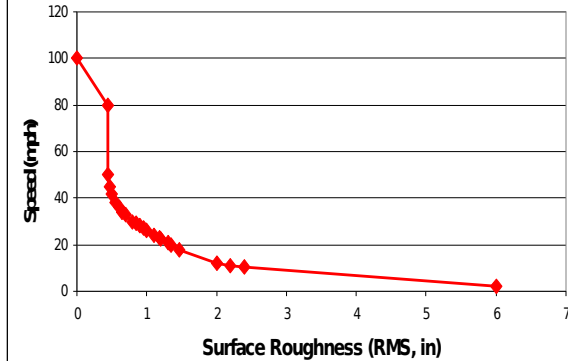
Tractive Force vs. Speed



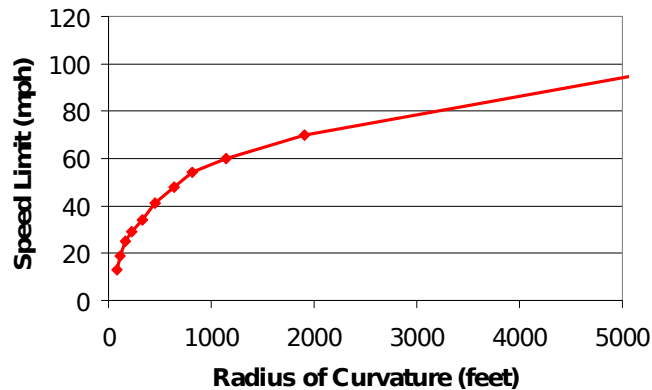
Vehicle Speed Limit vs. Tire Deflection



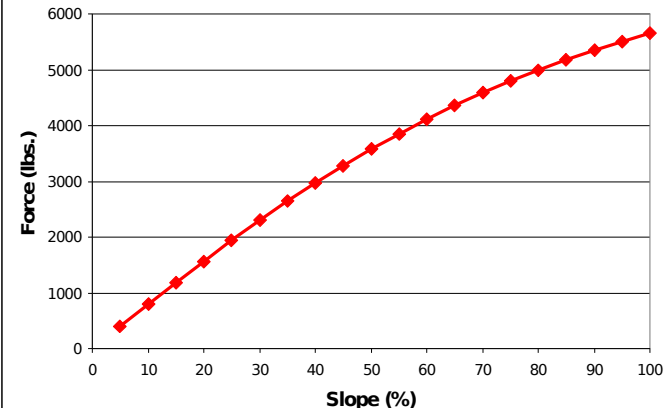
Vehicle Speed vs. Surface Roughness



AASHTO Speed vs. Curvature

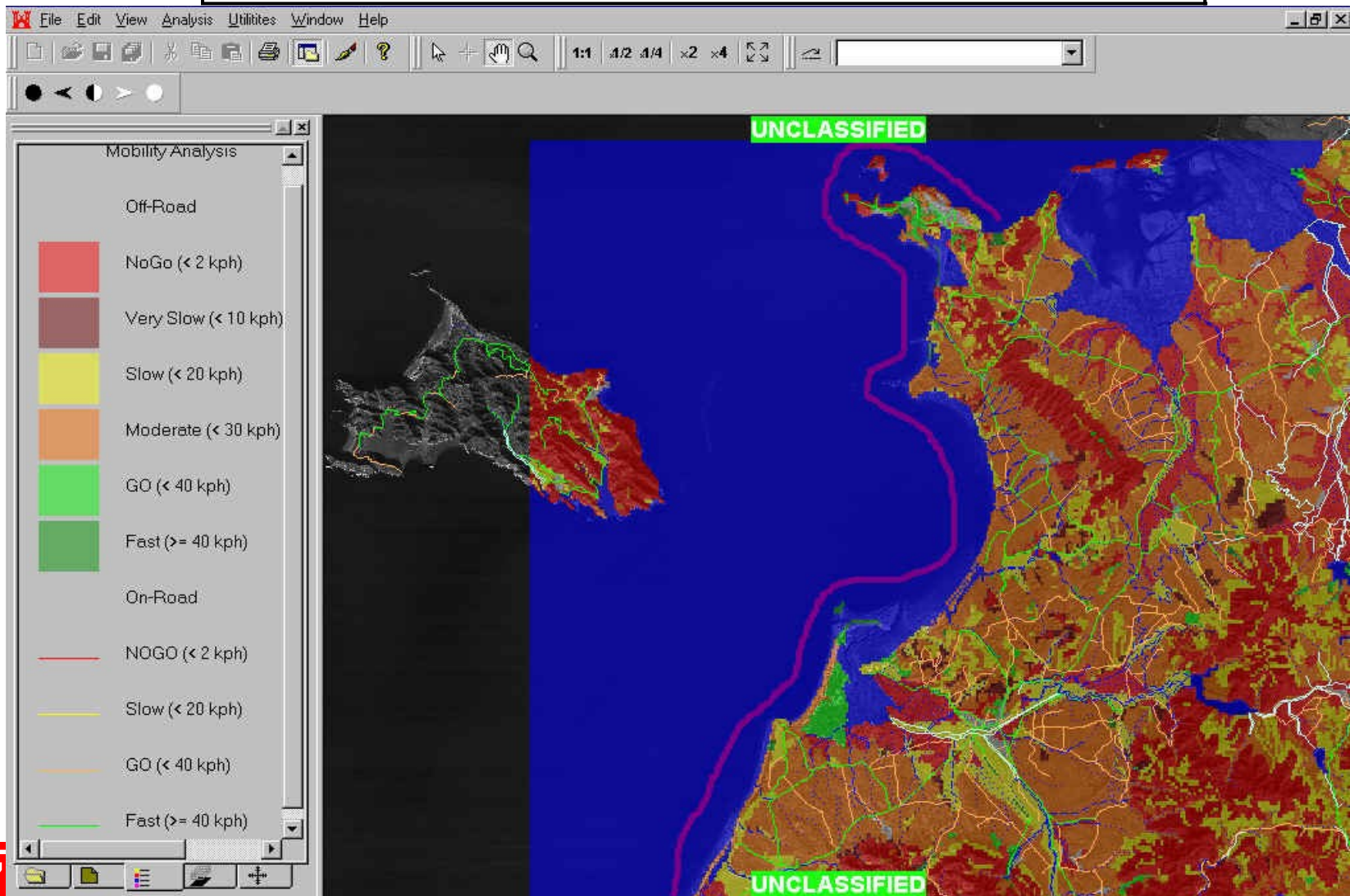


Force Due to Slope for 8,000 lb. Vehicle



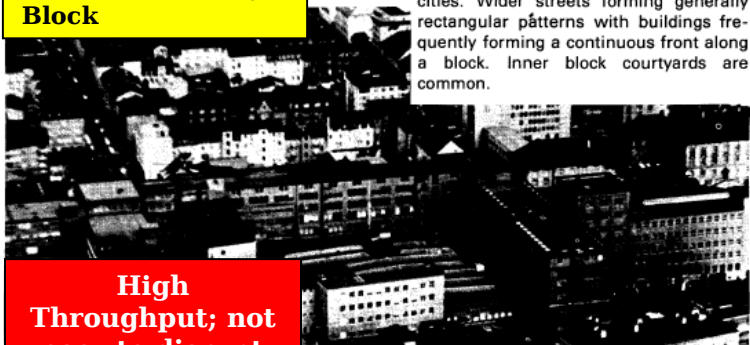
ERDC Mobility Modeling

Mobility Analysis for LAVIII in Wet Conditions



Throughput Potential for 5 Basic Urban Types

(Urban Types are from FM 90-10 MOUT)

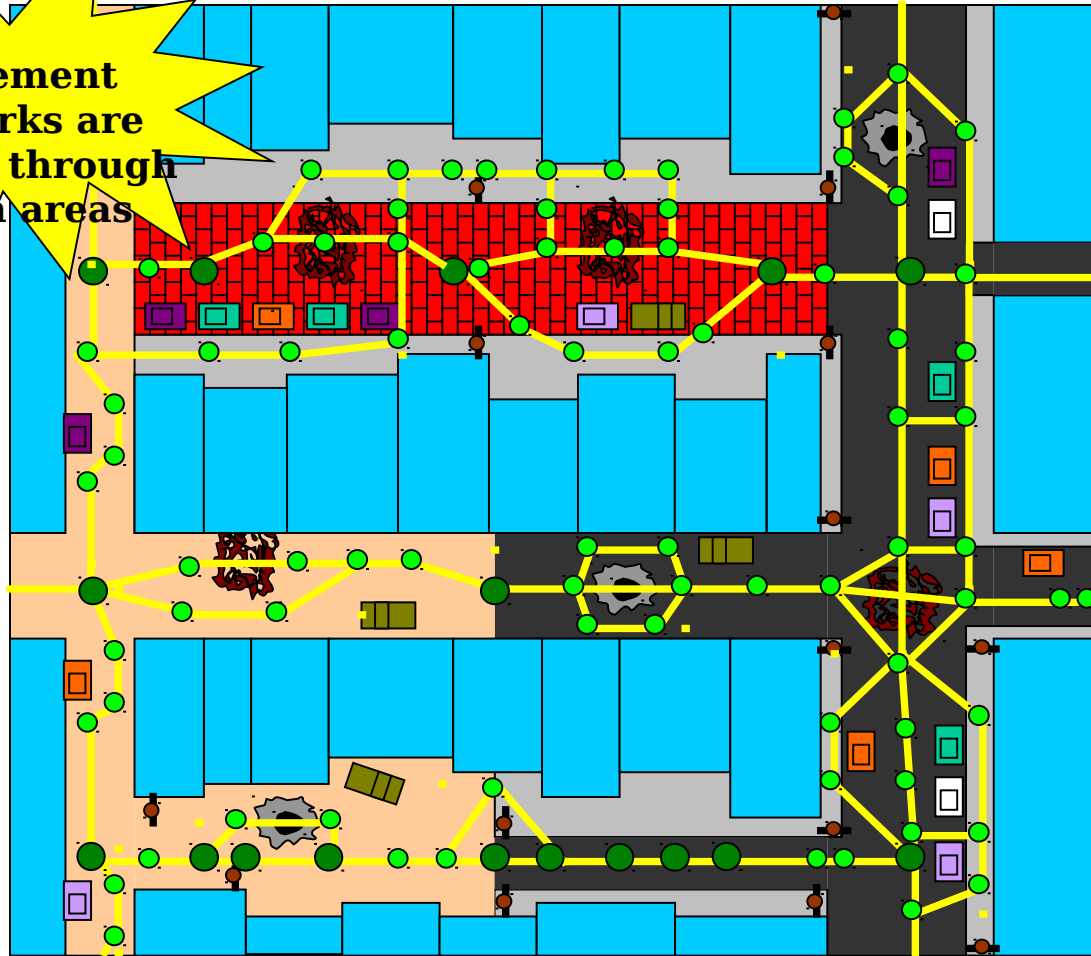
TYPE	GENERAL CHARACTERISTICS
A. Dense, Random Construction 	Typical old inner city construction with narrow winding streets radiating in an irregular manner from a central area. Found within cities, towns, and villages. Buildings are located close together and frequently along the edge of roadways.
B. Closed-orderly Block 	Common to central areas of towns and cities. Wider streets forming generally rectangular patterns with buildings frequently forming a continuous front along a block. Inner block courtyards are common.

Normally contiguous to Type B areas. Consists of rowhouses or single dwellings with yards, gardens, trees, and fences. Street pattern is normally rectangular or curving. 	C. Dispersed Residential Area Medium Throughput; hard to disrupt
Typical of modern construction in larger towns or cities. Consists of multistoried apartments, separated large open areas, and one-story buildings. Wide streets are laid out in rectangular patterns. 	D. High-rise Area High Throughput; not easy to disrupt
Older complexes may be found within Type A and B areas. New construction normally consists of low, flat-roofed factory and warehouse buildings. Generally located on or along the major rail and highway routes of the urban complex. 	E. Industrial/Transportation High Throughput; easy to disrupt

How do you classify ports and surrounding urban areas to generate the mobility/threat potential for an area.

Urban Route Planning for High Fidelity Throughput

Movement networks are created through urban areas



Throughput Information Sources

ERDC/GSL TR-01-21

Geotechnical and
Structures Laboratory



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A Standards-Based Movement and Infrastructure Aggregation Methodology for Mobility Representation in Modeling and Simulation

George B. McKinley, Niki C. Deliman, Terri C. Falls,
and Laura S. Bunch

October 2001



Approved for public release; distribution is unlimited.

Wheeled Vehicles - Low Mobility Class: M917

Wheeled Vehicles - Medium Mobility Class: M985

Wheeled Vehicles - High Mobility Class: M1084 Capacities, vehicles/hr

**Table 1
Plains**

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1128	862	564	300
	Secondary	824	792	564	300
	Trail	541	492	488	300
Wet-Slippery	Primary	1128	701	512	300
	Secondary	824	681	498	300
	Trail	405	390	357	300
Snow	Primary	1128	652	479	300
	Secondary	752	636	468	300
	Trail	705	540	400	300

**Table 2
Hills**

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1128	857	564	300
	Secondary	735	733	564	300
	Trail	433	414	357	300
Wet-Slippery	Primary	1128	694	507	300
	Secondary	735	669	491	300
	Trail	340	333	297	300
Snow	Primary	1041	645	473	300
	Secondary	653	625	459	300
	Trail	598	506	377	300

**Table 3
Mountains**

Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	934	846	564	300
	Secondary	612	565	560	300
	Trail	333	328	297	300
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	Trail	270	268	256	300
Snow	Primary	801	626	460	300
	Secondary	576	512	443	300
	Trail	427	335	311	300

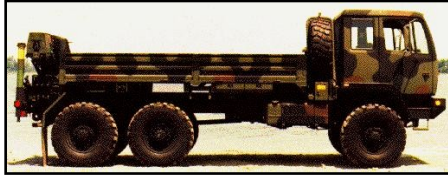
**Throughput Capacities Based
on 25 Vehicles per Column**



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M1084
High Mobility Wheeled



MLC E/L 11/15

M985
Medium Mobility
Wheeled



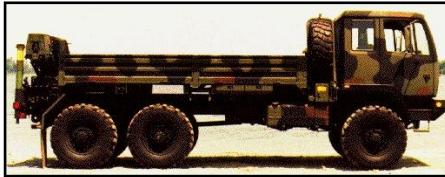
MLC E/L 18/28

M917
Low Mobility
Wheeled



MLC E/L 50/71

M1084/M1095
High Mobility Towed



MLC E/L 11/15

M985/M989
Medium Mobility Towed



MLC E/L 18/28

M911/M747
Low Mobility Towed



MLC E/L 16/79 11/79

M1A1
High Mobility



MLC E/L 70/70

M88A1
Medium Mobility
Tracked



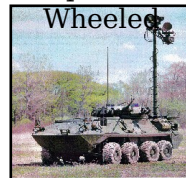
MLC E/L 55/70

AVLB
Low Mobility
Tracked



MLC E/L 46/66

LAV3
Amphibious
Wheeled



MLC E/L 11/11

M113A2
Amphibious
Tracked



MLC E/L 13/13



TSV/HSC Sample Load Configuration

209 Soldiers with gear

17 LAVs

2 FMTV Trucks

2 HMMWVs

Throughput Categories

17 Amphibious Wheeled

4 High Mobility Wheeled



Amphibious Wheeled Vehicles: LAV3 Capacities, vehicles/hr

Wheeled Vehicles - High Mobility Class: M1084 Capacities, vehicles/hr

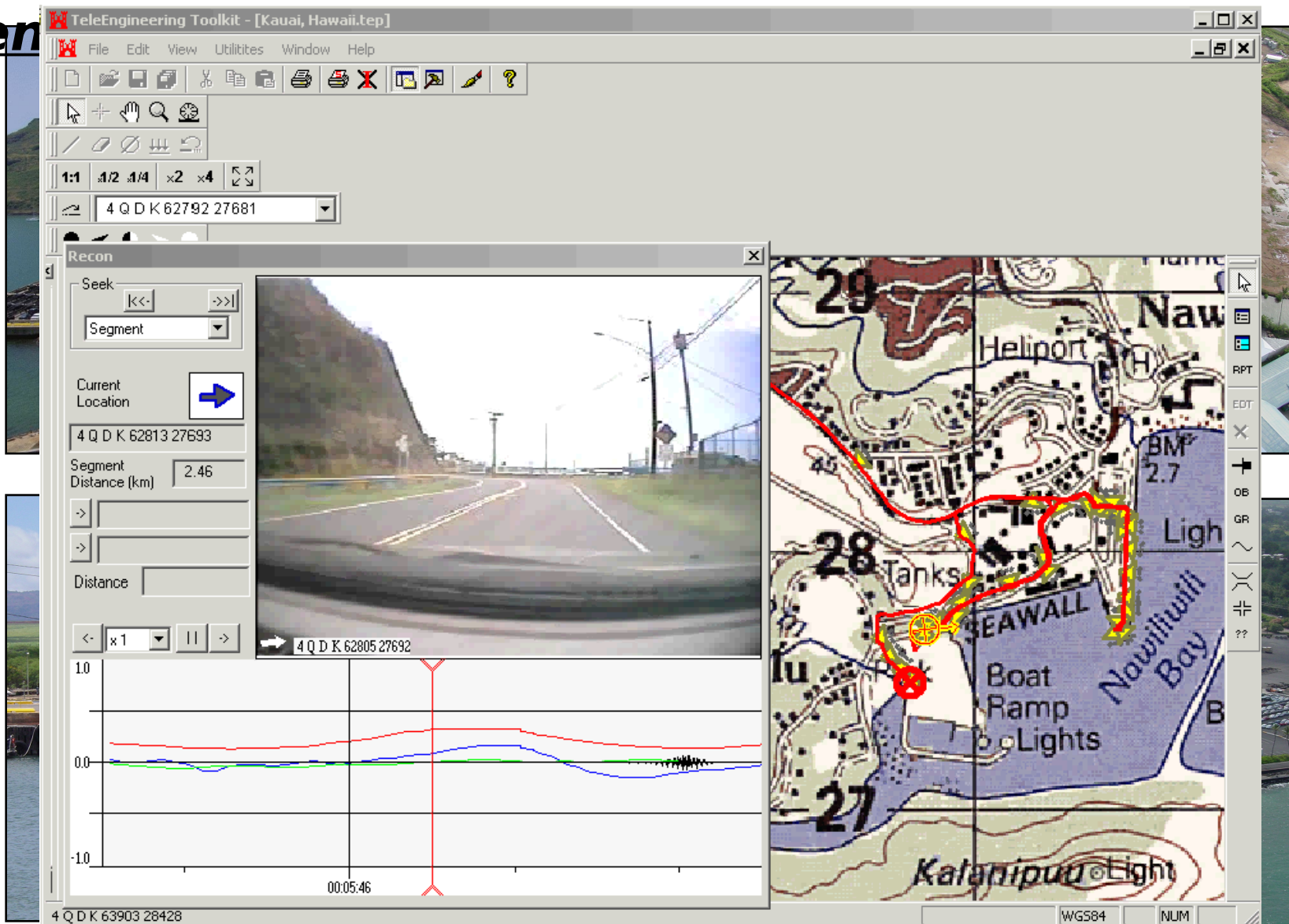
Scenario	Road Type	Normal	Fog	Limited	Blackout
Dry-Normal	Primary	1126	857	564	300
	Secondary	824	792	564	300
	Trail	541	492	488	300
Wet-Slippery	Primary	1126	701	512	300
	Secondary	824	681	496	300
	Trail	405	390	357	300
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	Secondary	578	512	443	300
	Trail	427	335	311	300



Air and Ground Recon (Nawiliwili & Port Allen)



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Wheeled Vehicles - High Mobility Class: M1084 Capacities, vehicles/hr

**Table 1
Plains**

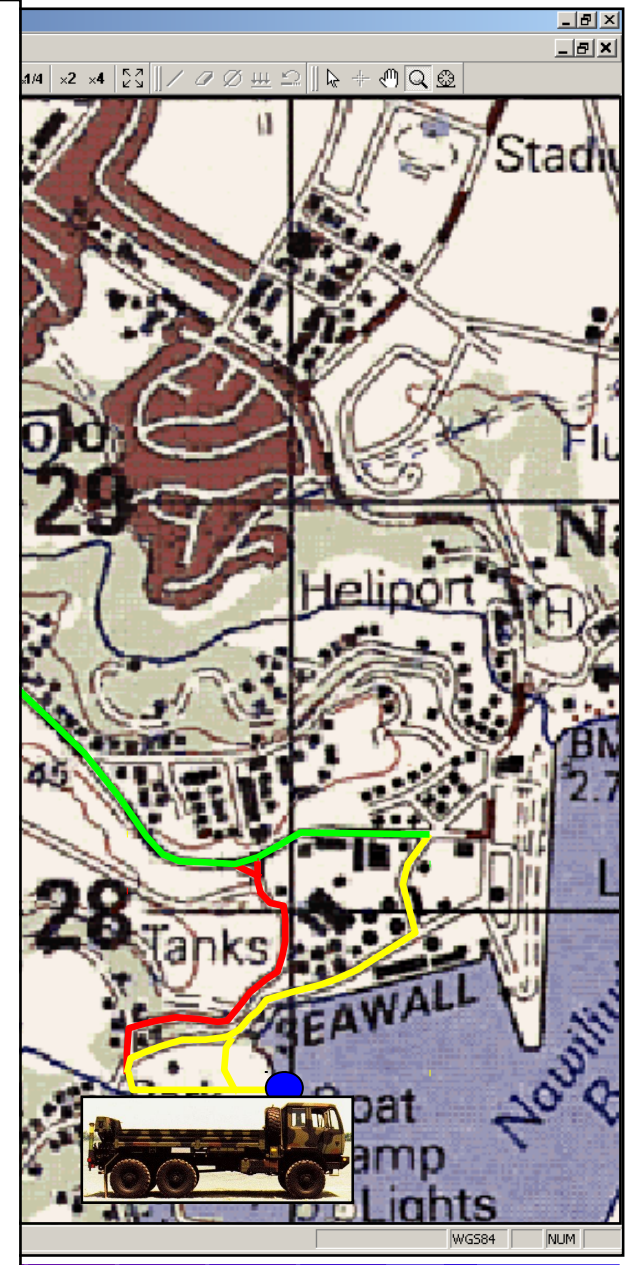
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**Table 2
Hills**

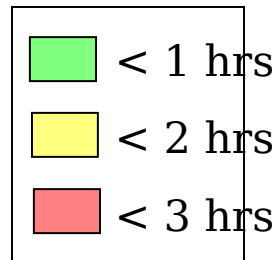
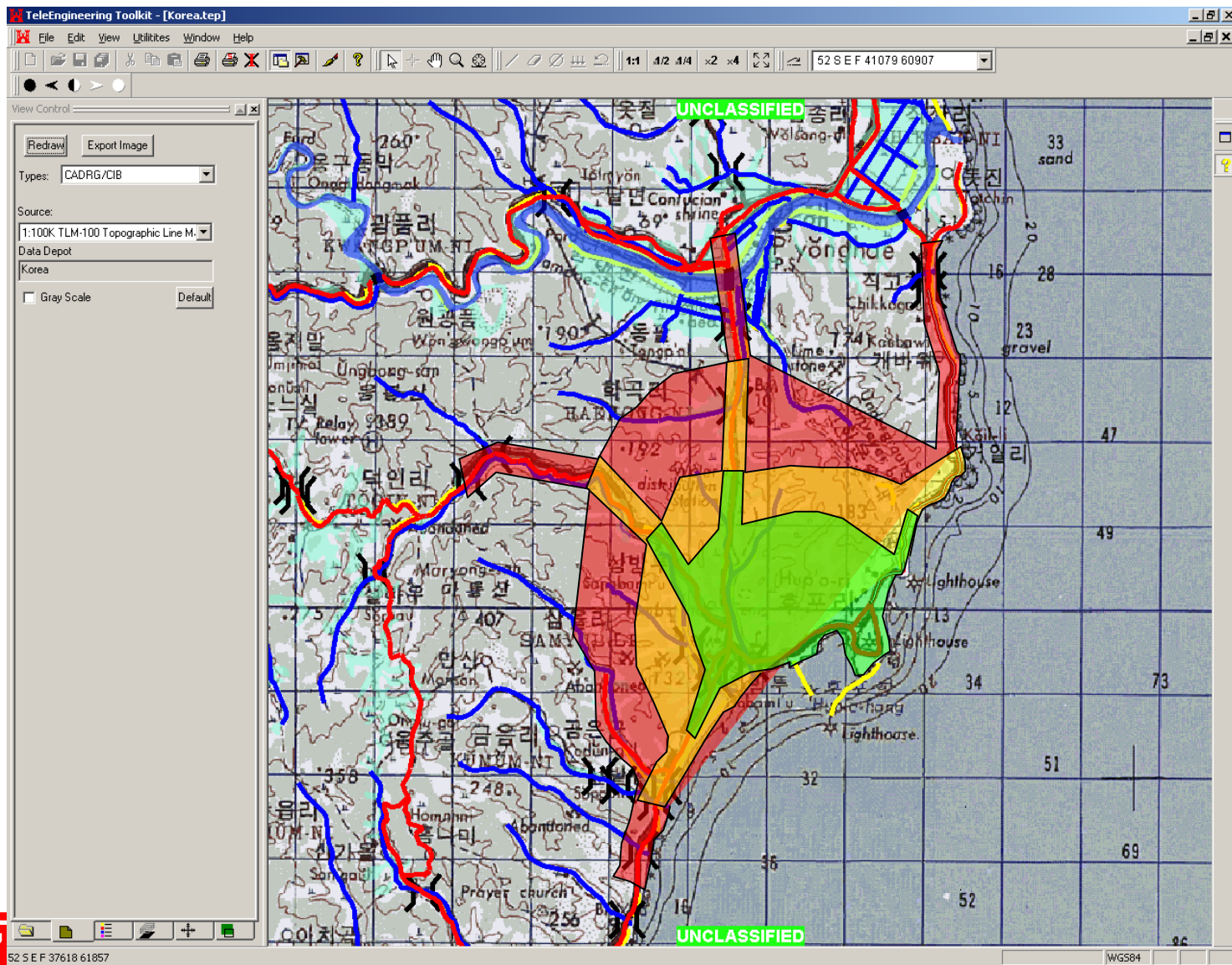
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**Table 3
Mountains**

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	Trail	427	335	311	300



Travel Time Contours

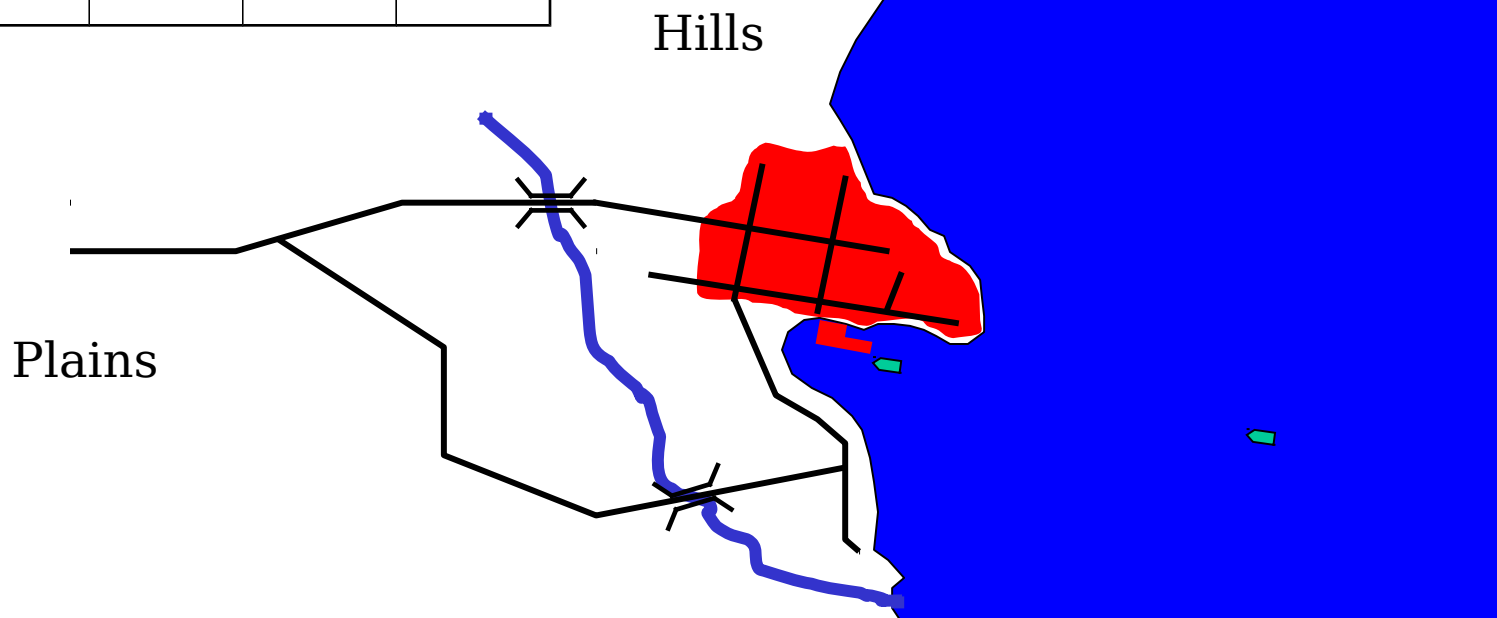


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What is the throughput from point of debarkation?

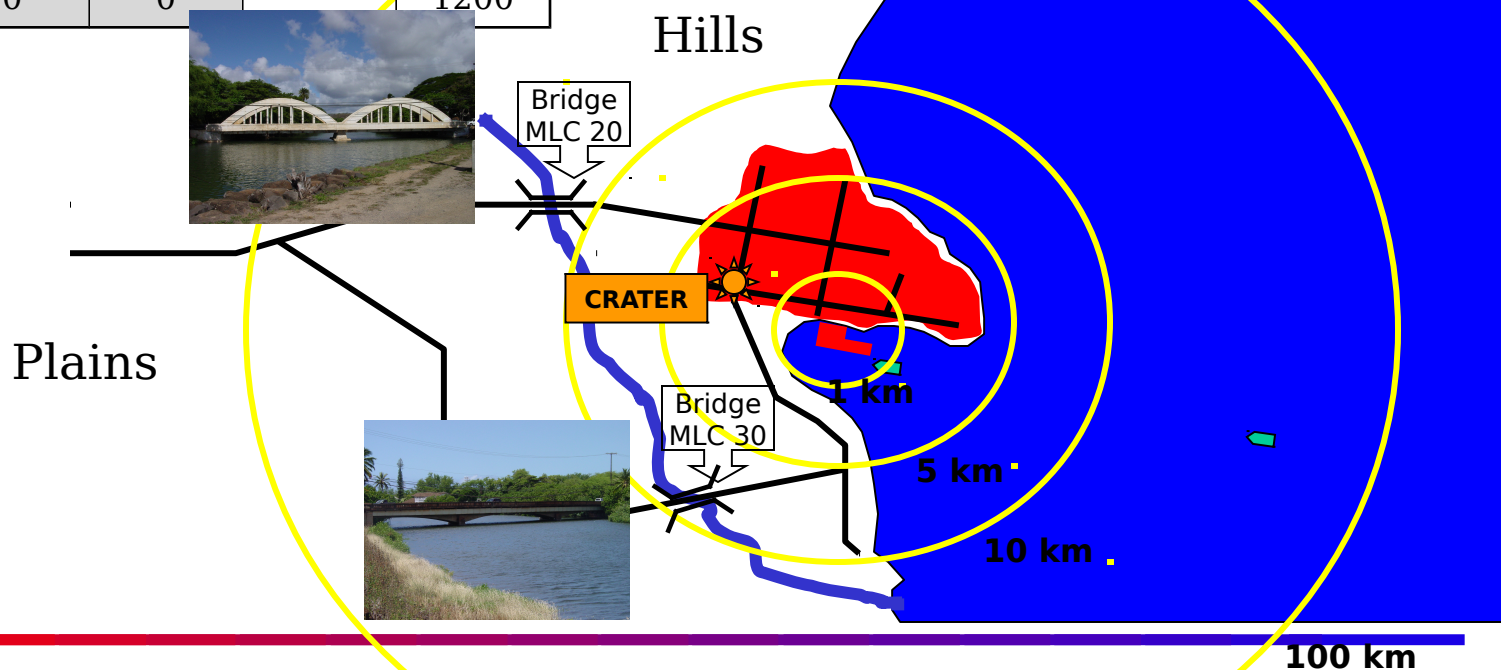
Veh/hr	Vehicle MLC			
Distance Ring km	70	40	***	10
1			***	
5			***	
10			***	
***	***	***	***	***
100			***	



What is the throughput from point of debarkation?

Veh/hr	Vehicle MLC			
Distance Ring km	70	40	***	10
1	1000	1000	***	1000
5	500	500	***	500
10	0	0	***	1000
***	***	***	***	***
100	0	0	***	1200

0 hrs



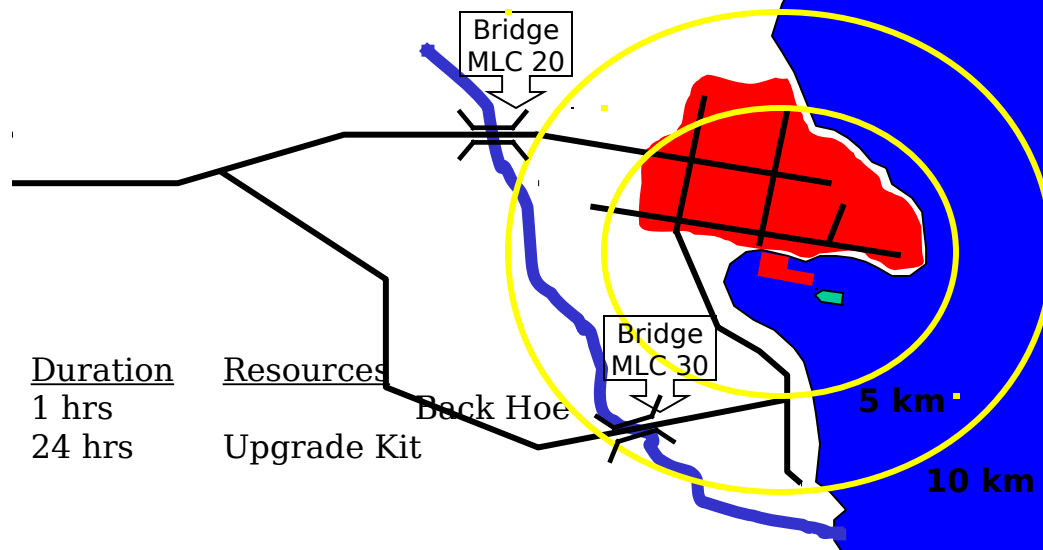
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the throughput from point of debarkation at time (t) with what EN res

Veh/hr	Vehicle MLC			
Distance Ring km	70	40	***	10
1	1000	1000	***	1000
5	1000	1000	***	1000
10	0	0	***	1000
***	***	***	***	***
100	0	0	***	1200

1 hrs
12 hrs
48 hrs



- Tasks
- ✓ Fix Crater
 - Upgrade Bridge

Duration

1 hrs

24 hrs

Resources

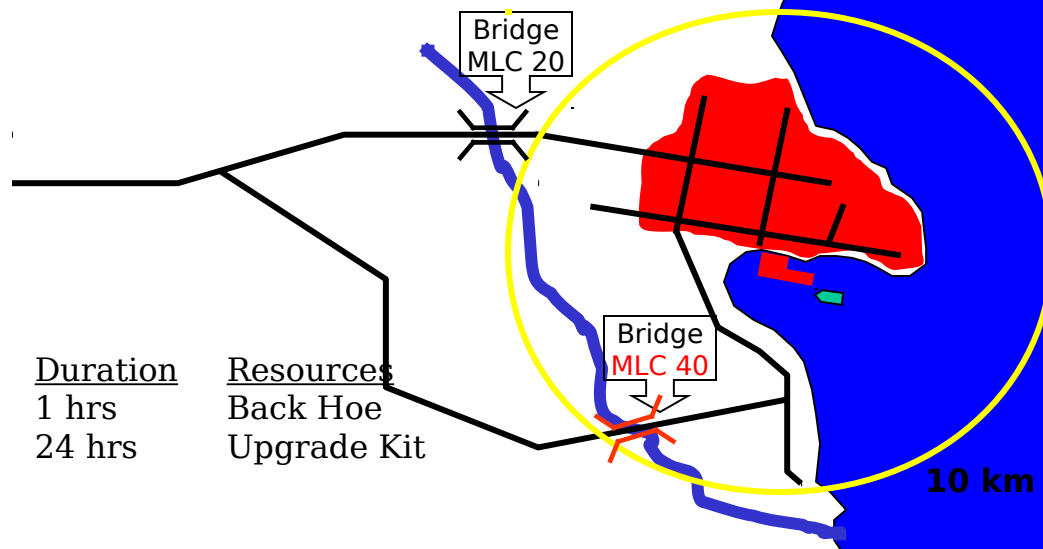
Upgrade Kit



the throughput from point of debarkation at time (t) with what EN res

Veh/hr	Vehicle MLC			
Distance Ring km	70	40	***	10
1	1000	1000	***	1000
5	1000	1000	***	1000
10	0	500	***	1000
***	***	***	***	***
100	0	1200	***	1200

24 hrs
48 hrs



Tasks
 ✓ Fix Crater
 ✓ Upgrade Bridge

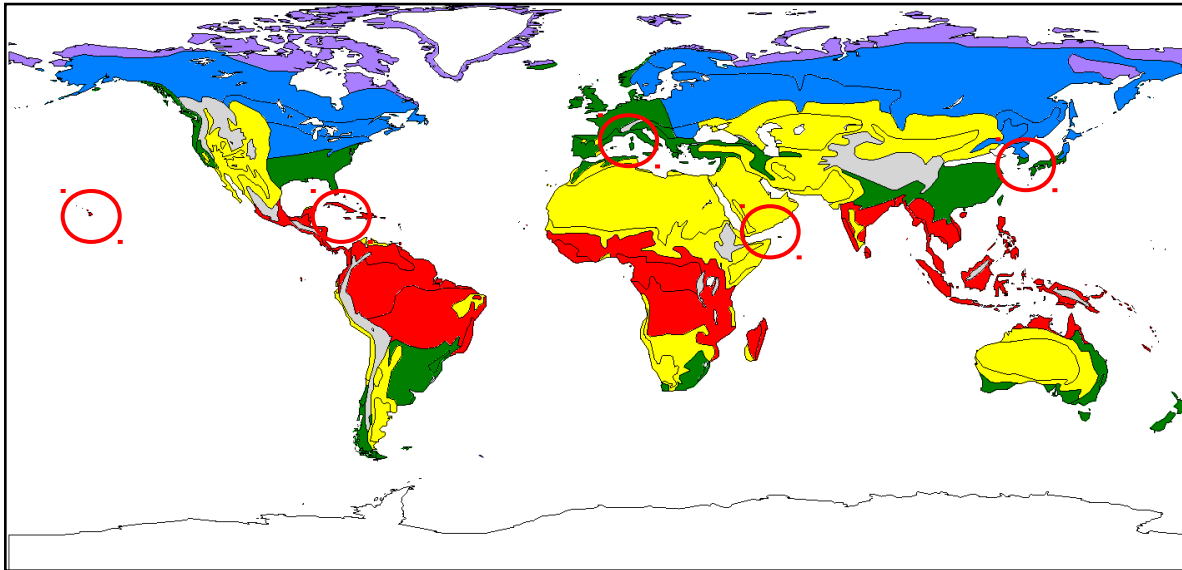
Duration
 1 hrs
 24 hrs

Resources
 Back Hoe
 Upgrade Kit



NEAR FUTURE DEMONSTRATION

- Select 5 austere ports and perform a detailed analysis including port characterization and ingress/egress throughout analysis
 - Data sources (NIMA products, topo sheets, vector data, satellite imagery)
 - Ground truth (recon tool, field measurements)
 - ERDC mobility modeling



QUESTIONS?



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